AIRS Total Column Ozone and Ozone Anomaly Quick Guide by NASA/SPoRT

Why are AIRS Ozone Retrievals Important?

AIRS Total Column Ozone (TCO) and Ozone Anomaly products developed by NASA/SPoRT can be used to diagnose regions of warm, dry, ozone-rich stratospheric air. These regions indicate the possible presence of a stratospheric intrusion or tropopause fold; features which aid cyclogenesis or can lead to non-convective high wind events. Carlson (1998) notes that inspection of the tropopause structure can aid surface cyclogenesis forecasts due to the fact that the time lag between initiation of strong 500 mb vorticity advection, tropopause folding, and cyclogenesis may be on the order of hours to a day or more.

How do I interpret ozone values and anomalies?

The ozone analysis by itself can be difficult to interpret. The ozone layer's average thickness is about 300 Dobson units (DU); however the climatological mean varies seasonally and spatially. Therefore, identification of stratospheric air based on high total column ozone values could lead to misinterpretation if the values actually range within climatology. Van Haver et al. (1996) identified stratospheric air and tropopause folds as layers where the ozone is at least 25% larger than the climatological mean. Ziemke et al. (2011) constructed a zonal monthly mean climatology of stratospheric ozone on a global scale derived from the NASA Microwave Limb Sounder. The Ozone Anomaly product was created by SPoRT as a percent of normal from this climatology, with a scale ranging from 0-200%. For ease of interpretation and significance, the scale on the Ozone Anomaly product switches to shades of blue at 125% and greater. Therefore any blue shade on the anomaly product represents stratospheric air.

What to look for in the imagery?

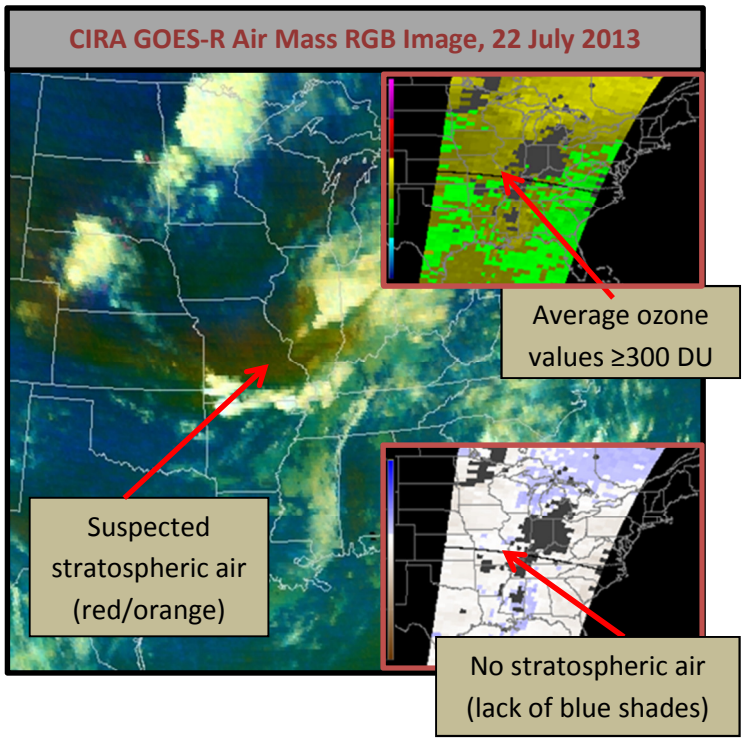
The Ozone Anomaly is intended to be used with products like the Air Mass RGB imagery, which only has qualitative colors for the user to interpret. Often, a red coloring results in the Air Mass RGB when a jet streak causes a stratospheric air intrusion (see reverse side). However, other dry air conditions can also result in red coloring in the RGB (see adjacent figure). The ozone anomaly product helps to quantify the red colors seen in the RGB. This confirms to the user whether it's really stratospheric air or not.

What is AIRS and when is it available?

The Atmospheric Infrared Sounder (AIRS) is an instrument on the polar-orbiting Aqua spacecraft, and it's available 2x/day, valid approximately 2:00 AM & PM locally (slight daily orbital variation) with a latency of about 4 hours. The instrument measures temperature and water vapor with height, as well as clouds, ozone, carbon monoxide, carbon dioxide, methane, sulfur dioxide, and dust.

Caveats

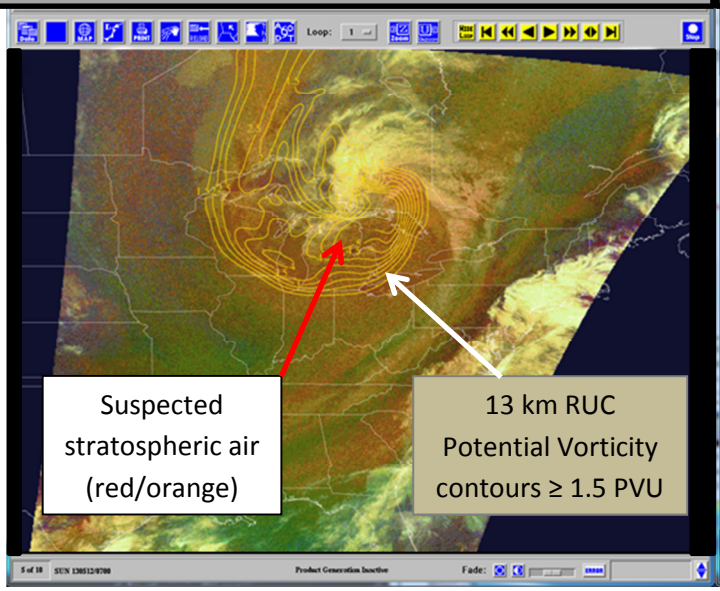
Thick clouds can interfere with the infrared energy measured by AIRS and therefore, result in missing values in these locations. To overcome the limitation in partly cloudy conditions, AIRS data are combined with data from microwave instruments on Aqua. Visit http://airs.jpl.nasa.gov to learn more about AIRS.



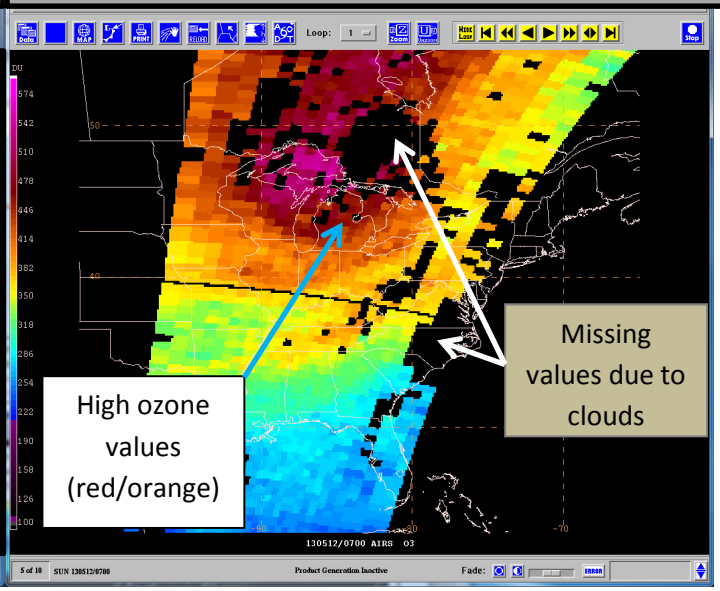
(see reverse side)

Example of AIRS Total Column Ozone and Ozone Anomaly compared to Air Mass RGB Imagery

MODIS Air Mass RGB Image, 12 May 2013

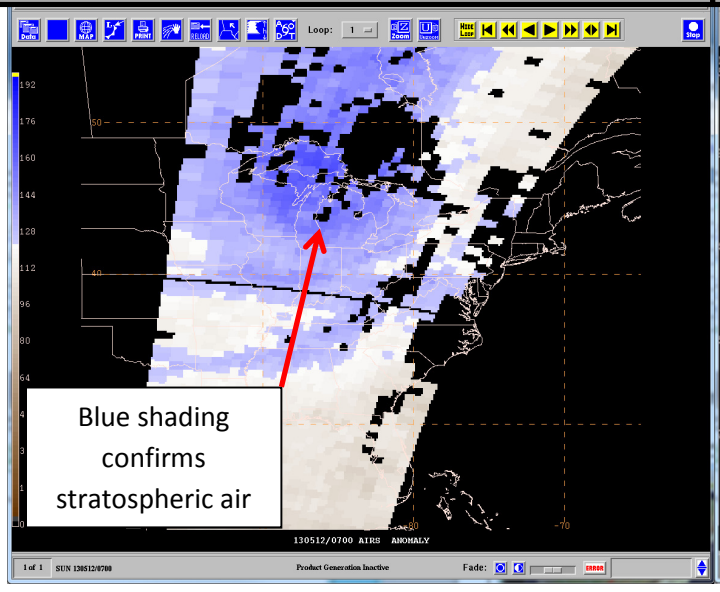


AIRS Total Column Ozone 12 May 2013

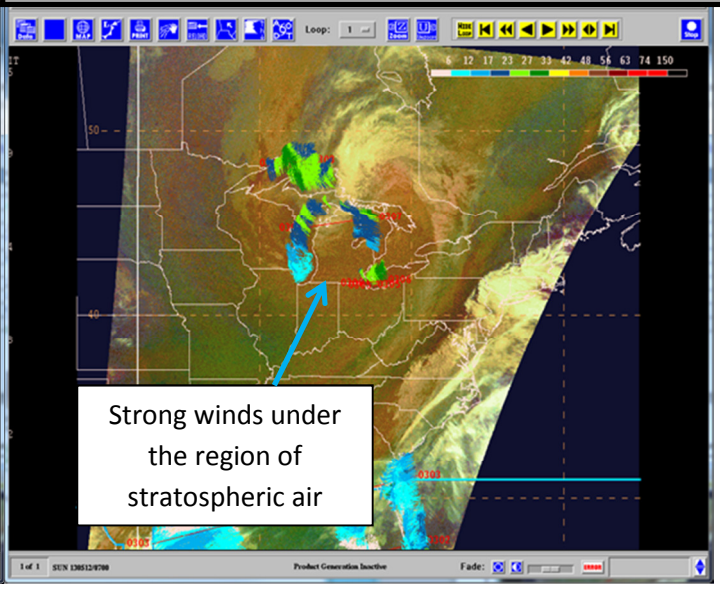


MODIS Air Mass RGB Image and AIRS Total Column Ozone in NAWIPS are from 12 May 2013. The orange/red regions near the Great Lakes in the Air Mass RGB Imagery (top left) indicate stratospheric air and high potential vorticity near a jet streak. High potential vorticity values at 0800 UTC in the 500-300 mb layer correlate with the stratospheric air on the Air Mass RGB Imagery. The top right diagram shows high values of ozone over the Great Lakes region at 0700 UTC. The Ozone Anomaly product (bottom left) shows the high ozone values are a significant enough deviation from climatology to be considered stratospheric air. Non-convective high winds tend to occur under the region of stratospheric air. ASCAT measured winds ranging from 52-64 knots (27-33 m/s) over western Lake Erie and 33-52 knots (17-33 m/s) over Lake Huron (bottom right).

AIRS Ozone Anomaly, 12 May 2013



MODIS Air Mass RGB Image, 12 May 2013



Resources

Operational applications can be seen on SPoRT's blog (http://nasasport.wordpress.com/) and the GOES-R and JPSS National Centers Perspective blog (http://goesrnatcentperspective.wordpress.com/) by clicking on the "AIRS" category.